Office of Environment, Safety and Health • U.S. Department of Energy • Washington, DC 20585

OPERATING EXPERIENCE SUMMARY

Office of Environment, Safety and Health

Summary 2001-12
December 17, 2001

The Environment, Safety and Health (EH) Office of Performance Assessment and Analysis publishes the Operating Experience Summary to promote safety throughout the Department of Energy (DOE) complex by encouraging the exchange of lessons-learned information among DOE facilities.

To issue the Summary in a timely manner, EH relies on preliminary information such as daily operations reports, notification reports, and, time permitting, conversations with cognizant facility or DOE field office staff. If you have additional pertinent information or identify inaccurate statements in the Summary, please bring this to the attention of Frank Russo, 301-903-1845, or Internet address Frank.Russo@eh.doe.gov, so we may issue a correction.

The OE Summary can be used as a DOE-wide information source as described in Section 5.1.2, DOE-STD-7501-99, *The DOE Corporate Lessons Learned Program*. Readers are cautioned that review of the Summary should not be a substitute for a thorough review of the interim and final occurrence reports.

Operating Experience Summary 2001-12

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NEXT ISSUE

OPERATING EXPERIENCE SUMMARY INDEX – 2001

The next issue of the OE Summary will contain an index of the lessons-learned articles published since resumption of the Summary in July of this year. Publication of an index in the final issue has been done in previous Summary years and will be continued, but in a new format. Events reported to ORPS during the holiday period will be reviewed for lessons-learned applicability and will be published in the 2002-01 issue on January 14, 2002. Please have a SAFE holiday.

EVENTS

1. TYPE B INVESTIGATION OF WORKER INJURED BY FAILED GROUTING EQUIPMENT

On October 15, 2001, a subcontractor operator of a grout injection rig received serious head injuries when he was struck by flying debris from a failed fitting assembly at the Cold Test Pit South area of the Radioactive Waste Management Complex at the Idaho National Engineering and Environmental Laboratory. While a high-pressure pump fed grout through a hose and into the ground, a newly purchased 45-degree swivel elbow and the adapter nuts connecting it to the pump and hose failed under pressure (see Figure 1). This propelled one of the adapter nuts into the worker's safety glasses, breaking the glasses and causing an injury to the right side of his head. The worker was hospitalized and required two surgeries to repair damage around his eye. The Idaho Operations Office completed a Type B investigation of the accident. (ORPS Report ID--BBWI-RWMC-2001-0028)

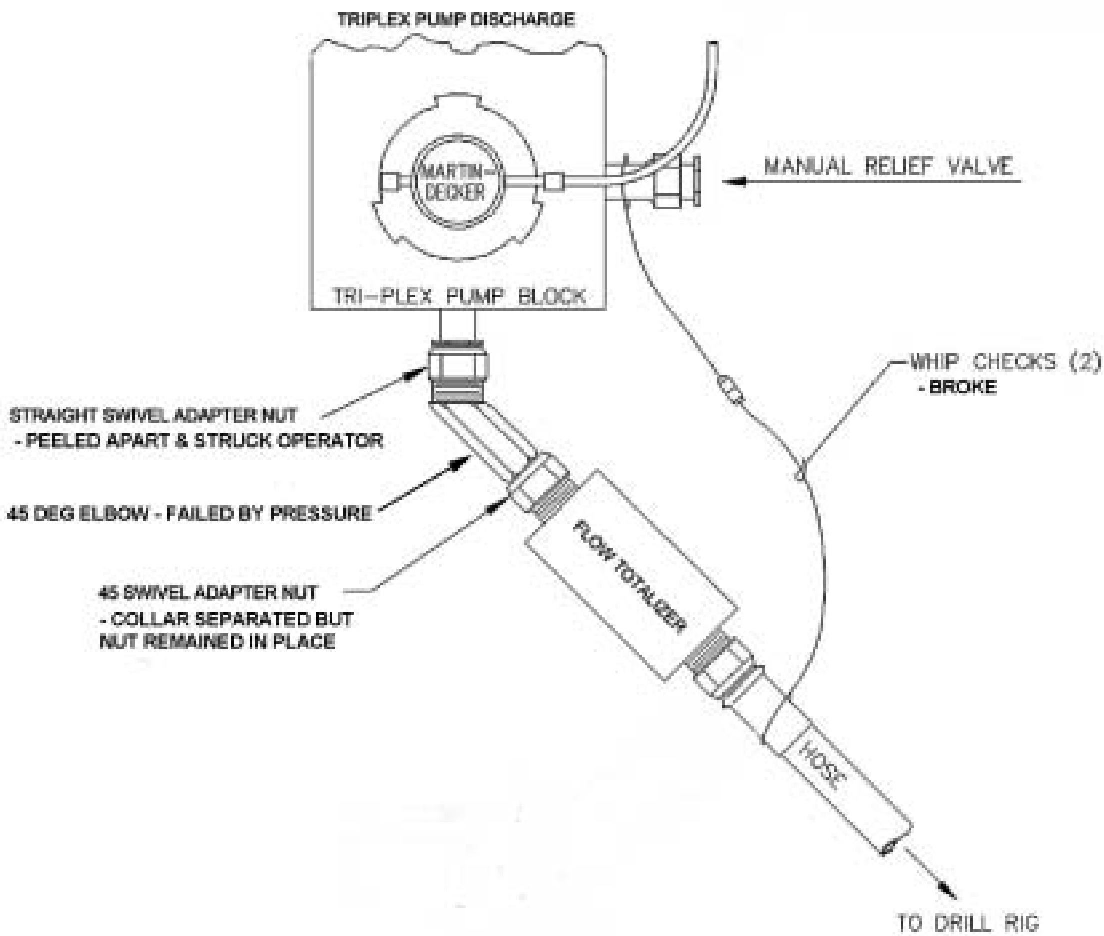

Figure 1. Diagram of fitting assembly

The investigation concluded that the direct cause of the accident was the use of a fitting not strong enough for the pressures seen in service. The 45-degree swivel elbow was rated for a maximum pressure of 3,000 pounds per square inch (psi), whereas normal pressure during grouting operations was 6,000 psi, and nozzle plugging could raise pressures above 10,000 psi. Nozzle plugging and leakage were recurrent problems during grouting operations. To repair leaks, the subcontractor had recently purchased and replaced hose and fittings, including the 45-degree swivel elbow. However, as evidenced by the failures, the subcontractor apparently did not understand the design and safety demands of his equipment, and installed parts inadequate for the pressure load experienced in service.

The investigation also concluded that the pressure shutdown features of the grouting system were ineffective and not well understood. An automatic pressure relief device downstream of the pump could have prevented over-pressurization caused by nozzle plugging.

In addition, the investigation attributed a number of programmatic weaknesses to this accident, including:

- Failure to analyze the hazards caused by nozzle plugging
- Failure to learn from previous equipment failures and precursor events
- Lack of knowledge about equipment safety features
- Failure to fully define quality acceptance or inspection criteria
- Failure to apply Integrated Safety Management (ISM) principles for the high-pressure grouting operation
- Lack of DOE guidance on pressure safety, beyond those for vessels

Further information about this accident and its investigation are found in DOE/ID-10968, *Type B Accident Investigation Board Report - Grout Injection Operator Injury at the Cold Test Pit South, Idaho National Engineering and Environmental Laboratory, October 15, 2001*, November 2001. Type A and B accident reports can normally be accessed through the DOE Accident Investigation Program website; however, this access is currently unavailable. In the interim, contact Dennis Vernon at (301) 903-4839 to obtain copies of reports.

2. ELECTRICAL ARC AND FIRE DURING COMPRESSOR STARTUP

On March 19, 2001, at the Pantex Plant, an electrical arc from a motor starter contactor for a newly installed chilled water compressor caused a small fire and a near miss injury to personnel. A manufacturer's technician was performing an initial startup of the chiller at the Building 12-5E Courtyard when the fire occurred. The technician retrieved a fire extinguisher from his truck and extinguished the fire. He then shut down the power, locked out the chiller, and removed the cover of the motor starter. There were no injuries and no adverse effects to the environment as a result of this event. The Final ORPS Report on this event was filed on September 5, 2001. (ORPS Report ALO-AO-BWXP-PANTEX-2001-0012)

Pantex crafts personnel had installed electrical cable to the newly purchased chiller, a pump, and polyvinyl chloride piping, and had left the area. The purchase contract for the chiller required that the manufacturer perform the initial startup. No Pantex technical personnel were present to ensure that proper safety requirements were observed in the performance of the startup. A technician representing the chiller manufacturer was performing a pre-startup checklist procedure. He wore appropriate personal protective equipment (PPE) and used a screwdriver with an insulated handle to manually energize the motor starter contactor for each of three compressors to check for proper fan rotation and compressor operation. When he energized the motor starter contractor for the third compressor, arcing occurred.

The root cause of this event was a policy not defined, disseminated, or enforced. No Pantex technical representative was assigned the responsibility to oversee the initial startup of the chiller unit and ensure that safety precautions were taken consistent with the plant Integrated Safety Management (ISM) program. Construction subcontractors are covered by safety plans and other safety oversight practices consistent with ISM. However, procedures do not exist that establish roles, responsibilities, or accountability for technical and safety oversight of other subcontractor personnel (e.g., factory technicians).

A potential contributing cause for the incident was the non-standard procedure of using a screwdriver with an insulated handle to manually energize contactors for fans and compressors. Manually pushing in the contactors to check for phasing is not in the manufacturer's manual, but it is a common practice employed by technicians during chiller installations to protect the equipment in case something has been miswired or other deficiencies exist. The equipment did not have a built-in mechanism to manually energize the contacts, and the technician did not have any special tools other than the screwdriver. This technique is required during the action to ensure that the motor contactors are released at the proper time, and in a crisp fashion. It is possible that some condition, improper technique, or equipment deficiency contributed to the arcing incident. Manually energizing contactors is not authorized at the Pantex Plant except by approved procedures. Standup meetings were held with crafts personnel to review this event and reinforce current practices and procedures.

The investigation of this event uncovered the fact that subcontractor personnel could come on site and perform work without any knowledge of the need to comply with the requirements of ISM. Construction projects require preparation of safety plans and the conduct of safety oversight activities; however, purchase orders can be placed that bring subcontractor personnel on site to perform work without formal safety oversight. In this event, there was no single Pantex technical representative accountable for the safety and safety oversight of the subcontractor technician. There were no controls implemented consistent with plant ISM procedures governing craft or construction contractor work, such as:

- requiring the preparation and approval of Safety Work Permits to evaluate the hazards and recommend appropriate controls including worker PPE,
- requiring the use of appropriate procedures and practices, and
- ensuring that affected personnel are notified of potentially hazardous situations.

This incident serves as a reminder that the contractor is responsible for compliance with ISM requirements, even if the work is performed by a subcontractor. [See 48 CFR 970, *DOE Management and Operating Contracts,* section 0470-2, paragraph (e)] Maintaining a safe work environment requires appropriate communication and enforcement of ISM requirements, procedures, and practices for all personnel performing work on the site.

KEYWORDS: *Near miss, electrical arc, fire, subcontractor safety*

ISM CORE FUNCTIONS: *Analyze the Hazards, Develop and Implement Hazard Controls, Perform Work within Controls*

3. REACTOR POOL WATER FLOODS AND CONTAMINATES LABORATORY

On October 17, 2001, at the Oak Ridge National Laboratory (ORNL) High Flux Isotope Reactor (HFIR), an operator failed to stop the pump filling the reactor pool as required by procedure. As a result, a large volume of pool water overflowed into the scuppers around the pool (see Figure 1). Excess water then filled and overflowed the pool surge tank, filled the collection tanks of the process liquid system, and backed-up through sink drains into the Neutron Activation Analysis Laboratory. Approximately 700 gallons of reactor pool water flowed onto the laboratory floor. Most of this water went down the laboratory drains but approximately 200 gallons went through some pipe penetrations and into the beam room, one floor below. Later measurements showed most contamination levels to be between 300 and 600 dpm/100 cm^2 beta-gamma; however, one isolated particle registered measured 6000 dpm. (ORPS Report ORO--ORNL-X10HFIR-2001-0026)

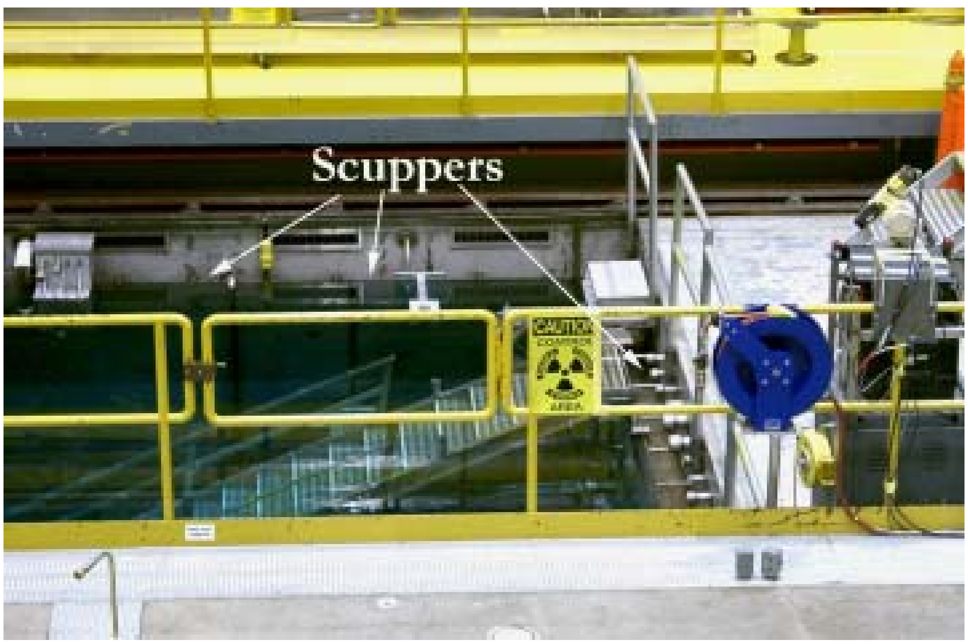

Figure 1. HFIR reactor pool

The operator intended to raise the reactor pool water up to the scupper level, approximately 2.5 feet above the original level of the pool. According to procedure, he was supposed to observe the rise of the water and stop the transfer pump as soon as water began flowing into the scuppers. However, the operator erroneously assumed that there was insufficient water in the storage tanks to fill the pool up to scupper level, and thus expected to have to use makeup water before pool overflow would occur. While pumping water from the storage tanks, he began reviewing procedures for other upcoming operations and monitored the rising pool level using a digital level indicator on the control room panel, rather than physically looking at the pool from the observation gallery or watching the video screen in the control room.

The operator waited for the digital level indicator to show a level of 848 feet, the scupper level. However, it remained at “847.9 feet” for several minutes as the pool began to overflow, unknown to him. Not until the Reactor Pool Level High Alarm sounded did he notice that the level indicator was at 848 feet and stopped the transfer pump. This alarm sounds when the pool level is about 1 inch above scupper level, which occurred in this case because the scupper drains became backed-up from the high rate of overflow. Subsequent analysis estimated that with the pump flow rate of 900 gallons per minute, the operator would have had only about 30 seconds to stop the pump between when the pool overflow started and when laboratory flooding began.

Investigators of this event concluded that its direct cause was the operator’s failure to physically observe the pool water level. However, they also concluded that weaknesses in the procedure and deficiencies in the system design contributed to the event. Although a previous Unreviewed Safety Question raised concerns that the recent overflow piping modifications reduced barriers preventing an overflow event, facility management had decided to continue to rely on operator actions and procedural controls.

As the result of this occurrence, overflow from the pool surge tank has been routed to the tritium process system, which has sufficient volume to accommodate any future pool overflows. Other corrective actions to be taken are:

- Revise the operation procedure to include specific information and direction for monitoring pool level, estimating and monitoring time to complete the water transfer, and monitoring pool surge tank level during pool water transfers
- Install a high-level alarm in the pool surge tank
- Develop operating procedures for lowering and maintaining the pool surge tank level
- Train the operator

This occurrence demonstrates that operators can make false assumptions and mistakes, and system designs and modification may need to anticipate such mistakes. It also shows that procedures must provide sufficient information and direction to help prevent operators from making mistakes.

KEYWORDS: *Reactor pool, water level, overflow, flooding*

ISM CORE FUNCTION: *Develop and Implement Hazard Controls*

4. BACKHOE RUPTURED A NATURAL GAS LINE DURING EXCAVATION

On September 11, 2000, at the Los Alamos National Laboratory Technical Area 16, the bucket of a backhoe struck and ruptured a 2-inch natural gas line during excavation. The breach allowed natural gas at a pressure of 88 psi to escape from the line. The backhoe operator failed to adhere to procedures that required hand excavation near buried utilities. No injuries resulted from the incident, and the line was isolated within 30 minutes of the rupture. No adverse impact to environment, safety, health, or program resulted from the incident. The Final ORPS Report on this event was filed on October 30, 2001. (ORPS Report ALO-LA-LANL-HEMACHPRES-2000-0002)

Utilities Department personnel were excavating to uncover, cut, and cap water lines that supplied Building 222 as part of an ongoing decommissioning project. Before they started the excavation, utilities personnel and Environmental Science and Application facility management prepared an excavation permit and developed a comprehensive work control package. After the permit and work control package was prepared and approved, utilities personnel used as-built drawings and industry standard directional radio frequency locating equipment to find all utilities in the areas to be excavated. In addition to locating the metal water lines, they found an active natural gas line and clearly marked the ground above the tracer wire for the gas line with yellow paint.

At a pre-job briefing, Utilities Department supervision and workers discussed the excavations to be performed that day and reviewed the work control package. The Activity Hazard Analysis in the work package required hand-locating all utilities before using heavy equipment. After the briefing, laborers and a backhoe operator began an excavation to locate a water line. However, while the laborers used shovels to dig approximately one foot into the soil; the operator used the backhoe to clear away the dirt. The excavation continued in this manner until they located the first water line. After uncovering the first water line, the workers moved to a second excavation area to locate and uncover a pressure-indicating valve on the water line.

In the second excavation area, the 2-inch gas line ran close to the valve of interest. As in the first excavation, the laborers used shovels to dig one foot into the soil, but because of the large rocks in the soil and because the backhoe operator thought he knew where the gas line was, he used the backhoe to clear the dirt away. While clearing away the dirt, an outside tine on the backhoe bucket struck the gas line and the operator immediately heard gas leaking from the line.

The direct and root causes were identified as personnel error (procedure not used or used incorrectly). The Activity Hazard Analysis required all utilities to be hand-located before using heavy equipment to perform excavations. In addition, the Health, Safety, and Environment Manual S-11, *Excavations*, states "Excavation work with powered equipment (without the use of probing) shall not commence until the marked utility or utilities are exposed." The crew performing the work did not comply with these requirements. They were adequately informed of the hand-locating requirements in the briefing and were adequately trained on the requirements in the manual.

To emphasize the importance of following excavation procedures, Utilities Department management conducted a 2½-hour stand-down of the department and retrained the employees on two specific Laboratory Implementation Requirements, those for "Excavation/Soil Disturbance Process" and "Stop Work and Restart." They also retrained employees on the *Excavations* procedure and the administrative procedure on *Excavation Requirements – Permit Process Requirements and Safety Program*. Other corrective actions that were taken included the following.

- Took administrative (disciplinary) actions with the two laborers, the equipment operator, and the supervisor of the job.

- Revised the administrative procedure *Excavation Requirements-Permit Process Requirements and Safety Program*. The primary revisions were potholing and excavation requirements, and a standard form titled *Excavation Permit Sketch*. The revisions also cancelled the *Excavation* procedure. Utilities Department management personnel trained the excavation employees on the administrative procedure revisions.

This event illustrates how skilled workers can become complacent when familiar equipment is repetitively operated and fail to recognize a situation that is potentially hazardous. The importance of hazard identification during work planning cannot be over-emphasized. Compliance with work control procedures associated with the hazards analysis is extremely important for worker safety.

KEYWORDS: *Excavation, backhoe, procedure violation*

ISM CORE FUNCTION: *Perform Work within Controls*

5. INHIBITED ALARMS RESULT IN UNDETECTED EQUIPMENT PROBLEMS

On October 11, 2001, at the Savannah River 232-H Facility, tritium process equipment failed to restart as expected following a reboot of a programmable logic controller. Operators did not recognize that the equipment was not operating properly because the audible alarm feature on a personal computer (PC) that receives equipment status information from the programmable logic controller was turned to an extremely low volume, which could not be heard by control room personnel. An investigation is being conducted to determine if any process equipment was damaged. (ORPS Report SR--WSRC-TRIT-2001-0012)

A programmable logic controller (PLC) controls process equipment with operator interface through a personal computer. On October 11, the PLC failed and a computer engineer had to completely shut it down and perform a reboot. The controller responded appropriately and came back online as the computer engineer expected. He then asked the control room operator if the process equipment was in shutdown status, and was told that it was. After a final verification that the status of all equipment was as expected, the engineer left the control room. No further problems were experienced on that shift or on the next shift.

On October 12, an engineer noticed that temperatures on local process controllers were indicated ambient temperature instead of normal readings. Electric heaters for the process equipment are controlled by the PLC based on the mode of the process equipment; the heaters are on in the operational and standby modes and off in the shutdown mode. The engineer entered the control room and looked at the personal computer screen and observed numerous alarms that had not been acknowledged. A review of the unacknowledged alarms indicated that the equipment had cooled after the PLC was rebooted the previous day, indicating that the heaters had not come back online as required. Furthermore, the speakers on the personal computer were turned to a very low volume so that the audible low-temperature alarms could not be heard. The adjustment was not logged or documented, and it is unknown who adjusted the volume or why. Additionally, the visual alarms on the personal computer screen were not observable because the screen saver was activated.

A critique was conducted and facility managers learned that when the computer engineer shut down the PLC, process heaters and pumps were also shut down. Upon reboot, the setpoint from the PLC to the temperature controllers automatically reset to 0ºC. Because ambient temperature was above this setpoint, the heaters did not switch on. None of the operations personnel was aware of the operating logic of the controller subsequent to a failure and reboot. The computer engineer, who understood this logic, had been told by the operations personnel that the status of the process equipment was “shutdown,” rather than “standby.” This miscommunication of the equipment status led the computer engineer to believe that the system was in its proper state.

Following the critique, an operational stand-down was declared, and personnel were briefed on the incident and the conduct of operations weaknesses, including alarm inhibits, log keeping, equipment status, and shift turnover procedures. Special emphasis was placed on standards for conduct of operations activities and management enforcement of these standards, as well as definition of the terms operational, standby, and shutdown to describe the status of the process. Training material was reviewed to ensure that these terms are properly defined and used in procedures and training materials.

Processes that rely on computer-generated annunciation of failures, such as the one described in this event, should be evaluated to ensure that the alarm system is functioning properly. Periodic operation of the alarms or test circuits, disabling the volume control, and disabling the screen saver should be considered. These actions were taken by personnel at the 232-H Facility in addition to design of a hardwired alarm for the subject equipment on the indicator panel.

Additional corrective actions planned for the 232-H Facility systems that could be considered at other facilities include:

- Prepare appropriate Alarm Response Procedures, Abnormal Operating Procedures, or other procedures/documentation as required to improve operator knowledge and help ensure that proper actions are taken in the event of a logic controller failure.

- Evaluate the manner in which controllers are rebooted and reloaded to provide a basis for development of a logic controller operability verification procedure.

The use of distributed control systems for process operations, which use PLCs, has increased in the industry and within DOE. Operating Experience Summary engineers are reviewing conduct of operations issues associated with operator controls and rebooting PLCs as a possible follow-up report.

KEYWORDS: *PC control room, PC screen saver, PC volume adjustment*

ISM CORE FUNCTION: *Provide Feedback and Continuous Improvement*